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Environmental Compliance and Energy Efficiency Strategies for Electric Arc Furnace Steelmaking

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The global transition toward green steelmaking has accelerated the adoption of Electric Arc Furnaces (EAF) in both standalone and integrated steel plants. While EAF technology offers flexibility in raw material use and supports decarbonization goals, its implementation introduces significant environmental and operational challenges. Compliance with increasingly stringent regulations on emissions, noise, and energy efficiency is essential for project viability and access to funding.

EAF operations generate substantial particulate matter, volatile organic compounds, and hazardous pollutants such as SO_x, NO_x, dioxins, and heavy metals. Modern dedusting systems must therefore go beyond conventional designs, incorporating tailor-made solutions for primary and secondary off-gas streams. Advanced gas cleaning concepts include water-cooled ducts, quenching systems, additive injection systems, and pulse jet filters, ensuring compliance with strict emission limits. Fugitive emissions are mitigated through enclosures such as doghouses or elephant houses, combined with optimized canopy suction systems supported by CFD-based design.

Noise emissions from EAF often exceed existing levels of traditional BOF converters, which causes challenges for plants located near metropolitan areas. Solutions include acoustic insulations, strategic layout planning, and structural enclosures. Doghouses not only reduce noise but also improve safety and reduce fugitive emissions. For auxiliary systems such as ID fans and filter plants, noise cladding and low-speed fan designs further contribute to compliance with authority requirements. A holistic planning of the noise mitigation concepts in the early planning phase of an EAF project is essential.

EAF processes release large amounts of thermal energy, creating opportunities for waste heat recovery. State-of-the-art systems capture off-gas heat to produce steam for on-site networks or district heating, reducing overall energy consumption and supporting sustainability targets. Integration of steam accumulators and hot water storage ensures stable supply despite fluctuating off-gas conditions. These measures not only enhance energy efficiency but also qualify projects for green funding initiatives.

Digital tools, including real-time emission monitoring, dynamic damper control, and optical fume detection, optimize dedusting performance and energy use. Intelligent control algorithms enable precise airflow management, reducing power consumption while maintaining environmental standards.

Through the integration of advanced gas cleaning technologies, comprehensive noise mitigation measures, and waste heat recovery systems, modern EAF installations can achieve compliance with stringent environmental and energy regulations. These measures not only minimize emissions and optimize resource utilization but also enhance operational performance and reduce lifecycle costs. By aligning with regulatory frameworks and sustainability targets, such projects position steel producers to secure green funding opportunities and strengthen their competitiveness.

Speaker Country

Austria

Speaker Company/University

Primetals Technologies

Primary author: TRUNNER, paul (Primetals Technologies)

Presenter: TRUNNER, paul (Primetals Technologies)

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